DORIS NETWORK

2012 STATUS REPORT
1. CONTEXT AND EVOLUTION

BACKGROUND
REGINA PROJECT
MAINTENANCE AND EVOLUTION
NETWORK DEPLOYMENT
LOCAL TIE SURVEY
GEODETCIC DATA
1. BACKGROUND

- **REORGANIZATION**
  - Agreement CNES/IGN renewed (end 2008)

- **SYSTEM REQUIREMENTS**
  - Specifications for station installation

- **CO-LOCATION WITH OTHERS SPACE GEODETIC TECHNIQUES**
  - ITRF
  - GGOS

- **AGEING NETWORK**
  - Revisit the stations as far as possible
  - Installation of remote management system (35/56)

- **REGULARIZATION**
  - Bring into general agreements with host agencies
  - Have frequencies clearances put in order
1. REGINA PROJECT

“RÉSEAU GNSS POUR L’IGS ET LA NAVIGATION”

- Global network of over 30 stations, based on DORIS network, well distributed
- Project launched by CNES with the support of IGN
- Main objectives:
  - Global multi-GNSS real-time network:
  - Positioning: real-time determination of orbits and clocks
  - Contribution to: IGS, EUREF, ITRF

REGINA AND DORIS

- Contribution to ITRF: co-location GNSS/DORIS
- Improvement of the local tie survey accuracy
- Opportunity to strengthen contacts with host agencies
- Follow-up visit of many DORIS sites
1. REGINA NETWORK DEPLOYMENT

Operating

Planned

IDS WORKSHOP, VENICE, SEPTEMBER 25th, 2012
1. DORIS NETWORK MAINTENANCE

- **COLLABORATION UNDER AGREEMENT BETWEEN CNES & IGN**

- **ORGANIZATION**
  - CNES is responsible for the operational issues of the stations (signal integrity monitoring, maintenance, support, development, shipment).
  - IGN is put in charge of all relevant geodetic activities for the network maintenance (station installation and renovation, global geodetic survey and all operations upon antenna, the reference point).
  - IGN also deals with negotiation with host agencies, agreements drafting, frequency clearance applications, …

- **REGULAR CONTACT AND COORDINATING MEETINGS**
1. NETWORK DEPLOYMENT BY IGN

- **1986-1990: OPERATIONAL SET-UP**
  - First station installed in 1986
  - 32 stations in 1990 (launch of Spot-2 = start of the system)

- **1990-2000: DENSIFICATION**
  - Global network design ensuring a homogeneous coverage
  - Possible co-location with GPS
  - 54 stations

- **2000-NOWADAYS: RENOVATION**
  - System more exacting and effective
  - Instruments upgrade
  - Stability and better environment for the antenna

- **TODAY**
  - Well distributed geographically worldwide
  - Keep up performance level
  - Increase co-location with other space geodetic techniques and tide gauges
1. LOCAL TIE SURVEY

**DORIS NEEDS**

- Determine coordinates of the antenna reference (ARP)
  - New station: tie vectors with available points
  - Renovation: tie vector with the former reference point

- Tie DORIS to other local geodetic point
  - mark, GNSS, SLR, VLBI, tide gauge…

**DORIS REFERENCE POINT**

- Physical point: intersection of the antenna axis and the red disk

- In theory: vertical projection of the measurement point (2GHz phase centre) on the horizontal plane containing the 400MHz phase centre

- Problem: link physical point and measurement point
  - Phase centers location to within 5mm (specifications)
  - Manufacturing defect (bad alignment)
  - Installation defect (verticality)

- We measure physical points ≠ virtual points (phase centers)

- Necessity: mark under the antenna = geodetic print of DORIS
1. LOCAL TIE SURVEY

- **CONVENTIONAL METHOD**
  - Combining terrestrial measurements of angles, distances and height differences
  - Computing differential coordinates expressed in a topometric frame
  - Referencing into a global frame (ITRF)

- **OPERATIONAL CONTEXT**
  - Big equipment to forward: shipping - customs clearance difficulties
  - Remote areas: unforeseeable delivery time and inactivity of our equipment
  - Many local ties were done with GPS surveying method

- **DORIS GOVERNING BOARD DECISION (23/01/12)**
  - Favorable context with REGINA: high precision local tie surveys
  - Objective: submillimetric tie vectors precision

- **OTHER ACTIONS**
  - Equipping sites with geodetic control points in order to monitor the monumentation stability
  - Qualifying all former tie vectors through a new computation
2. NETWORK STATUS AND PERSPECTIVES

NETWORK EVENTS
NETWORK AVAILABILITY
QUALITY INDICATORS
CO-LOCATIONS
NETWORK EVOLUTION
NETWORK DENSIFICATION
### 2. NETWORK EVENTS

<table>
<thead>
<tr>
<th>Year</th>
<th>Station</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td></td>
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<tr>
<td></td>
<td><strong>December</strong></td>
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<tr>
<td></td>
<td>Chichijima</td>
<td>Reconnaissance JAXA / GSI</td>
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<td></td>
<td><strong>January</strong></td>
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<td></td>
<td>Toulouse</td>
<td>Equipment upgrade (3.1)</td>
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<td></td>
<td>Papeete</td>
<td>Local tie survey (new REGINA station) + reconnaissance 3.2</td>
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<td></td>
<td><strong>February</strong></td>
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<td></td>
<td>Terre Adélie</td>
<td>Beacon replacement</td>
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<tr>
<td></td>
<td>Rothera</td>
<td>Renovation (antenna raising) + local tie survey</td>
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<td></td>
<td>Kourou</td>
<td>Renovation + local tie survey (new REGINA station)</td>
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<td></td>
<td><strong>March</strong></td>
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<td></td>
<td>Socorro</td>
<td>Reconnaissance for major renovation</td>
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<td></td>
<td><strong>May</strong></td>
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<td></td>
<td>Dionysos</td>
<td>Local tie survey (new REGINA station)</td>
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<td></td>
<td><strong>June</strong></td>
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<td></td>
<td>Yarragadee</td>
<td>Equipment upgrade (3.1) + remote control system</td>
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<td></td>
<td><strong>July</strong></td>
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<td></td>
<td>Easter Island</td>
<td>Beacon replacement</td>
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<td></td>
<td>Nouméa</td>
<td>Renovation (antenna raising and equipment replacement)</td>
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<td></td>
<td><strong>August</strong></td>
<td></td>
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<td></td>
<td>Futuna</td>
<td>Reconnaisance (preliminaries before renovation)</td>
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<td></td>
<td>Rikitea</td>
<td>Equipment replacement + local tie survey (new REGINA station)</td>
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<tr>
<td></td>
<td><strong>September</strong></td>
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<td></td>
<td>Arequipa</td>
<td>Beacon replacement</td>
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<tr>
<td></td>
<td>Sakhalinsk</td>
<td>Removed from the network (out of order since 2006)</td>
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<td></td>
<td><strong>October</strong></td>
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<tr>
<td></td>
<td>Manille – St Helena</td>
<td>Beacon replacement + remote control system</td>
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<tr>
<td></td>
<td>Metsähovi</td>
<td>Reconnaissance with a view to collocate with GNSS + SLR+VLBI</td>
</tr>
<tr>
<td></td>
<td>Mahé</td>
<td>Beacon 3.2 installing, reconnaissance with a view to move</td>
</tr>
</tbody>
</table>
## 2. NETWORK EVENTS

<table>
<thead>
<tr>
<th>2012</th>
<th>Station</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>All</td>
<td>New coordinate and velocity set (DPOD/ITRF2008)</td>
</tr>
<tr>
<td>February</td>
<td>Rikitea</td>
<td>Beacon replacement</td>
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<tr>
<td></td>
<td>Sal – Réunion - Kitab</td>
<td>Remote control system installation</td>
</tr>
<tr>
<td>March</td>
<td>All</td>
<td>New set of site logs (major data updating and revision)</td>
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<tr>
<td></td>
<td>Reykjavik</td>
<td>Beacon replacement</td>
</tr>
<tr>
<td></td>
<td>French West Indies</td>
<td>Reconnaissance in Guadeloupe and Martinique (IGS colocation)</td>
</tr>
<tr>
<td></td>
<td>Rio Grande</td>
<td>Antenna replacement (position unchanged)</td>
</tr>
<tr>
<td>April</td>
<td>Futuna</td>
<td>Major renovation + local tie survey (new GNSS station ‘FTNA’)</td>
</tr>
<tr>
<td></td>
<td>Terre Adélie</td>
<td>Equipment upgrade (3.1) + Maser and antenna replacement</td>
</tr>
<tr>
<td>May</td>
<td>Greenbelt Everest</td>
<td>Renovation (antenna raising and equipment replacement)</td>
</tr>
<tr>
<td></td>
<td>Everest</td>
<td>Remote control system installation</td>
</tr>
<tr>
<td>June</td>
<td>Tristan Da Cunha</td>
<td>Major renovation + local tie survey</td>
</tr>
<tr>
<td></td>
<td>Metsähovi</td>
<td>Renovation + local tie survey (new REGINA station)</td>
</tr>
<tr>
<td>August</td>
<td>Port Moresby</td>
<td>Renovation (antenna raising and equipment replacement)</td>
</tr>
<tr>
<td>September</td>
<td>Djibouti</td>
<td>Beacon replacement + remote control system</td>
</tr>
<tr>
<td>October</td>
<td>Jiufeng Hokkaïdo</td>
<td>Renovation + local tie survey (new REGINA station)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reconnaissance (GNSS + VLBI co-location)</td>
</tr>
</tbody>
</table>
2. NETWORK AVAILABILITY

Current status of the 57 stations

- 88% Operating
- 5% Out of Order
- 7% OoO for over a year

Out of Order for over a year:

Yuzhno-Sakhalinsk (11/2005), Santa Cruz (06/2009), Socorro (10/2009), Monument Peak (02/2010)
2. NETWORK AVAILABILITY

- RESULT OF THE JOINT EFFORT OF CNES AND IGN
- 28 BEACONS OUT OF 56 REPLACED IN 3 YEARS

**Percentage of operational stations since October 2010**

*From CNES/SALP data*
2. QUALITY INDICATORS

- BASED ON DORIS SYSTEM REQUIREMENTS (DSR)
- 3 STATION CLASSES:
  - Class A: at least 90% of DSR satisfied
  - Class B: 80 to 90% of DSR satisfied
  - Class C: less than 80% of DSR satisfied

Two years follow-up

<table>
<thead>
<tr>
<th>Date</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/2012</td>
<td>26%</td>
<td>53%</td>
<td>21%</td>
</tr>
<tr>
<td>Stations</td>
<td>15</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Target</td>
<td>40%</td>
<td>50%</td>
<td>10%</td>
</tr>
</tbody>
</table>
2. CO-LOCATIONS

- DORIS STATIONS CO-LOCATED WITH OTHER IERS TECHNIQUES

[Map showing co-locations of DORIS stations with other IERS techniques]
2. CO-LOCATIONS

- DORIS STATIONS CO-LOCATED WITH TIDE GAUGE

- Distance DORIS – Tide gauge < 500 m
- Dist. < 3.6 km
- 3.6 km < Dist. < 10 km
- No co-location
2. NETWORK EVOLUTION

**SHORT RUN (NEXT 6 MONTHS)**

- Jiufeng: renovation, local tie survey (new GNSS station)
- Syowa: antenna replacement
- Mahé: antenna moving, local tie survey (new GNSS station)

**LATER**

- Goldstone: new station in place of Monument Peak
- Socorro: major renovation (equipment, antenna moving…)
- Miami: definitive shutdown (interferences with TV-mobile)
- Chatham: host agency moving
- Hokkaido: new station in place of Sakhalinsk, co-location GNSS+VLBI
- Kitab: major renovation
- Easter: major renovation
NEW STATIONS

Chichijima: installation planned in 2013
Fr. West Indies: installation planned in 2013
Nicaragua: under negotiation, co-location GNSS
Korea: under negotiation with KASI, co-location GNSS+SLR+VLBI
Wake island (Marshall): under consideration
Tamanrasset: lying dormant
Riyadh: abandoned (frequency clearance default)